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Environmental Control | Material Handling

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The Extension Service Review is for Extension educators—in County, State, and Federal Extension agencies—who work directly or indirectly to help people learn how to use the newest findings in agriculture and home economics research to bring about a more abundant life for themselves and their communities.

The Review offers the Extension worker, in his role of educational leader, professional guideposts, new routes and tools for speedier, more successful endeavor. Through this exchange of methods, tried and found successful by Extension agents, the Review serves as a source of ideas and useful information on how to reach people and thus help them utilize more fully their own resources, to farm more efficiently, and to make the home and community a better place to live.

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EXTENSION SERVICE
REVIEW

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CONTENTS

EDITORIAL

The future is already here—ALMOST.

Since Way-Back-When, man has been striving to control not only his own environment but that of plants and livestock as well. He has also been striving to find every better way of moving things from where they are to where he wants them.

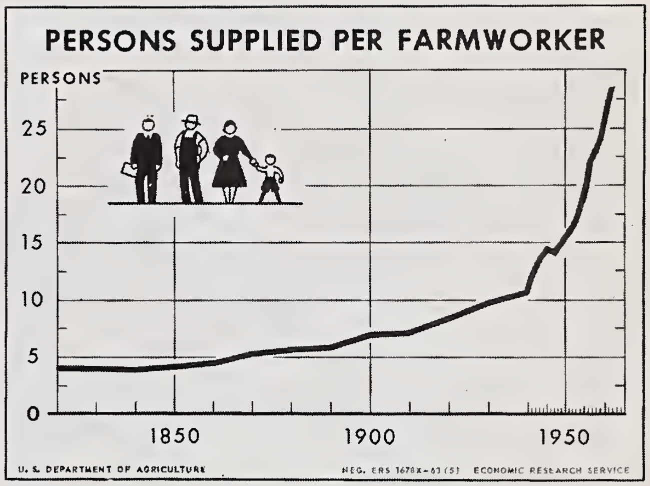
Nature is indifferent to mankind. Good Old Mother Nature lavishes as much attention on a fire-ant or rag-weed as it does on a honey bee or wheat. She will turn clouds upside down and give you a flood, scorch the land with day after day of 90 and plus temperatures, and then do an about face and give you gentle rains and moderate temperatures.

Now getting the best of Good Old M.N. isn't easy. But it can be and is done as you well know. From fans to insulation and points between, a good deal of progress has been made to get temperatures and humidity nearer the ideal. And when it comes to moving things, progress is also the watchword.

This special issue of the *Review* tells of some current Extension educational work—with farm people and others—on environmental control and material handling.—WAL

The World of Materials Handling and Environmental Control

by ROBERT O. GILDEN, *Agricultural Engineer Federal Extension Service*



Energy

Man's quest for knowledge in understanding the physical world can be best illustrated by his ceaseless search to use and understand energy. Our technological explosion has been built upon this knowledge—some of our current sociological problems can be traced to the substitution of energies as we move from one source of energy to another. This substitution of energy has been the history of man as it moved from manpower to animal power, to wind power, water power, to steam, to internal combustion engines or petroleum power, to electrical, and on to nuclear power. Each of these changes has had a pronounced effect upon farming and agriculture as a whole.

Many of us have lived through some of these changes. I think we all agree that in the words of the showman, "You ain't seen nothing yet!" For example, the direct conversion of petroleum to electrical energy at high efficiency is a fact. Direct solar energy has never been fully utilized. Nuclear energy has yet to be fully explored. Energy sources in the ultraviolet and infra-red regions are just beginning to be realized for the potentials they carry. This knowledge and its application to agriculture will predicate that the only constant we have is change. We are in a dynamic agriculture where the utilization of these energies for material handling and environmental control, is limited only by the knowledge and the economics of the moment.

It is always interesting to compare manpower to electrical power. The 100 watt light you read by—one manpower couldn't keep it burning. Try turning a generator some time and see just how much power you can generate. It's equally interesting to speculate on the developing countries. Why aren't they mechanized? Electrified? Why haven't they substituted energies as we have? Maybe the answer lies partially in the fact that human energy is as cheap as animal-electrical-petroleum.

As the U.S. Department of Agriculture just celebrated its 100th anniversary in 1962 it is interesting to note the change in energy source in our agriculture over this same period of time. One hundred years ago it was something like this—machine 19 percent, animal 65 percent, man 16 percent. Today—machine 99 percent, animal less than 1 percent, man less than 1 percent.

In the last 40 years we have seen petroleum energy replace animal energy in the field, and in the past 20 years we have seen electrical energy replace man-energy on the farmstead. Could there be a correlation between the number of people fed by food produced by one farmer in 1864, 1924, 1944, and 1964?

In spite of this progress, researchers of some typical milking operations on some typical dairy farms (if there is such a thing) estimated that the energy wasted through unnecessary movements by U.S. dairyman in 6½ days would put a 1,000-pound cow over the moon. A most popular concept in the space age—yet an indication of the importance of planned work sequences.

Materials handling

The work done by industry, research, and Extension in the overall field of materials handling has been flowering the past few years in U.S. agriculture. Commercial farms are searching for ways to remove the "human element" from their operation. They, like industry, are searching and using materials-handling systems that make an agricultural factory out of their operations. Also like industry, they want to use the cheapest, most dependable energy available.

Materials handling is always most notable in the "harvesting" operation. An example of a large operation is a feedlot where feed is transported mechanically and processed through electronic feed mills, distributed by a truck which automatically weighs and records feed distributed, and where cattle and feed are continually programed through the lot. Small "family farm" feedlots are tending toward a completely automated system of feed distribution by use of small proportioning mills, time clocks, augers, etc. The materials handling and preparation for storage of the feed is usually different in the above two feedlot operations, but the principle of a complete materials-handling system remains.

Mechanical harvesting of fruits such as cherries, peaches, prunes, apples, and pears, by tree shaking and catching frames has changed labor efficiency and horticultural practices as well as handling systems. New varieties, such as some tomatoes, have been developed to fit a mechanical harvester system. Pressure sensing devices for firmness—as in head lettuce harvesting, light transmittance as in quality of apples for storage, or reflectance as in lemon sorting—all add to changes that influence the materials-handling system and make it a continuing change. Field or farmstead cooling, processing, packaging, and bulk handling from farm through market also contribute.

Changes also cause problems, particularly where provisions for a complete materials-handling system was not established or where previous cultural practices have changed. Waste management from livestock and processing enterprises is such a problem. Increasing numbers of people in the rural-urban fringe as well as concentration of livestock have focused attention on this.

Odors, flies, water pollution, and dust generate social and health pressures for immediate solution that may not be economically feasible. Research and Extension have been devoting resources to this problem to obtain a more adequate body of facts for its solution, or eliminate the problem before it arises.

When we look at the total agricultural picture—as we move products from field, to farmstead, to processing, to market, to consumer—this becomes a gigantic materials-handling problem. We in Extension are engaged in the solution to this problem. In the substitution of energies and arrangement of materias flow to help us arrive at the most efficient system within the economics of the moment.

Environmental control

Whether man's quest for environmental control has produced energy substitutes or vice versa is a moot point, the two have certainly gone hand-in-hand throughout history. As new sources of energy were found they were applied to the area of environmental control for man, for animals, and for plants. Most of the recorded history of environmental control has been devoted to man.

We are just now entering the age of animal and plant environmental control. Our knowledge is still skimpy, but growing. Physioenergetic chambers for animals and plant growth chambers for plants are starting to fill out our knowledge As this happens we are finding additional environmental effects which change our requirements and design criteria. Temperature and humidity limits for optimum production are changing housing systems most markedly in poultry, swine, and dairying. Effects of light, or darkness, on plant growth and flowering are changing greenhouse operations—this same photoperiodism has indications of carrying through to the animal world as well. As we learn more we can expect larger educational challenges as we move laboratory results to the field within a situation that is compatible with the economics of the moment.

We are now faced with a new environmental factor—hazardous when existing in the extreme, as is temperature, or pressure. This factor we term radiation—the release of energy from overexcited atoms and a byproduct of some forms of nuclear energy. The knowledge of this new environmental factor and the methods for its control put a new challenge into our educational system and another factor into our design criteria to control an environment that is compatible with the economics of the moment.

Conclusion

We in Extension have played a leading role in the past and will play an even more important role in the future as we continue to bring knowledge and people together for their mutual use and for the benefit of all mankind. The prayer of "Give us this day our daily bread" has, in this country, been temporarily answered. This is not true in most other parts of the world. It will not be true in the tomorrows of our Nation if we hold the *status quo* of research and development (Extension). As we meet this threat in our country, and in other parts of the world, we will see even greater application of the science of materials handling and the application of controlled environment to offer the optimum in efficiency and quality within the food chain. ■

Extension Tackles Potato Ventilating Problem

by ERIC B. WILSON, *Agricultural Engineer and* RICHARD E. OHMS, *Potato Specialist Idaho*

THE IDAHO RUSSET BURBANK potato could lose its envied position as the best "baker" and preferred "processor" unless Idaho producers equip their potato cellars to hold potatoes at peak quality for many months after harvest.

Existing farm storages do not keep potatoes at desirable temperatures for the best processing or far enough into the summer months to supply the fresh market.

Research at the University of Idaho has determined that good-quality potatoes could be maintained into the summer months with adequate ventilation and chemical growth regulators.

It was up to Extension to get producers to install ventilating systems in their potato cellars.

A bulletin—*Idaho Potato Storages—Construction and Management*—was released in late summer, 1963. It called attention to good construction techniques and emphasized the addition of forced-air ventilation to existing potato storage structures.

This wasn't enough. Even those farmers who were convinced that ventilation was necessary didn't have the aptitude or enthusiasm to follow through the bulletin to the point of designing a system and ordering the necessary parts.

Local ventilation equipment dealers were canvassed. They would furnish whatever equipment the farmer asked for but were not particularly interested in helping him with the design.

A search for commercial firms interested in putting together a predesigned, prewired, and preadjusted package of ventilating equipment and controls was undertaken. Several such firms were located. However, the air distribution system would be somewhat different for each installation. Even these firms could not design the duct systems for every cellar except at a cost seemingly out of proportion to the value. They would, however, provide the equipment and controls package at a reasonable cost.

Thus, Extension still needed to devise a method whereby each farmer could get his duct system designed.

Potato schools were scheduled for early in 1964. A session at each school was devoted to storage and ventilation. First the growers were told of the seriousness of the situation, that ventilation was the answer, and then how to design and install ventilation.

To obtain potatoes suitable for long storage it was necessary to point out the cultural and harvesting procedures necessary for sound tuber production. This involved things such as (1) clods formed during seedbed preparation producing injury to tubers at harvest; (2) the use of good seed to avoid tuber-rot diseases which cause trouble in storage; (3) the timing of irrigations at the start of the season and stopping irrigation early in the fall so that well shaped, mature potatoes free from water rot go into storage; (4) the use of correct rates of fertilizers; and (5) the proper adjustment and handling of harvest equipment to avoid bruising potatoes.

A work sheet was prepared to help show how to design and install ventilation equipment. This was tried at the first school and abandoned. It required too much arithmetic for most farmers to follow.

For the second school we used a table which listed precalculated values of duct and fan sizes for a dozen typical potato cellars. If the table didn't show an example exactly like his own, the farmer could find one or two which were fairly close. From these examples he could estimate sizes required for his cellar.

This approximation method seemed to be accepted. We decided the resulting "sizes" would be close enough and that more cellars would be converted if this method were used.

From this program we hope Idaho farmers will be able to meet the challenge to supply high-quality potatoes to both the "fresh" and "process" markets on a year-round basis. ■

report of a three-year effort

Agricultural Sanitation

by JOHN J. McELROY, *Extension Program Leader, California*

WHEN urban sprawl rubs shoulders with poultry, dairy, and other livestock farms, human friction occurs because of animal odor, dust, and flies. What can be done to reduce such friction?

After facing up to the problem for 3 years, California Extension has found a variety of possible answers. But no simple solutions have developed and at times solutions beget other problems.

Conflict at times has become serious, including charges and countercharges, difficulties between neighbors, ordinances, and economic stresses. Lawsuits have not been limited to city dwellers suing the farmer. Farmer has objected to farmer, charging that the lack of sanitation affected the production of crops.

Problems of agricultural sanitation center around flies, odors, and dust. These are closely interrelated. A high degree of fly control may increase the problem of odors or of dust. It is possible to control odors, but that control may bring about conditions that encourage fly breeding or dust development. We may be able to control the dust but in so doing, create an environment for fly-breeding or odor development.

Agricultural sanitation is not a problem of agriculture alone. It can be an irritant and an economic factor both on the farm and in the urban area. Flies are not localized but may move considerable distances. They breed in decaying lawn clippings and plant trimmings, garbage cans, dumps, sewage disposal plants, and in wastes from food processing plants, as well as in barnyards, poultry runs, and among the wastes of crop harvests.

The problem is a community one, calling for community effort. Because it is a community problem—concerned with irritations, health, community appearance, and satisfactory living environments—it is also a problem for interagency action. No one agency can reach all areas of the problem. Pooling resources of the several agencies is a step toward solution.

Agricultural sanitation requires the knowledge and contributions of the entomologist, the engineer, the agronomist, and the soils expert. It needs the biological and chemical information of the entomologist and the chemist. It needs the engineer to design the structures and equipment, select the materials, and plan the layouts which assist in basic sanitation. It needs the agronomist and soils men with their knowledge of organic fertilizers and the utilization of agricutural wastes. It requires, above all, coordination and management to deploy these resources well.

The University of California recognizes the importance of rural sanitation. Research workers are learning more about the use of animal wastes as fertilizer. In San Diego County, men from the Riverside Campus of the University and the San Diego Poultry Association are cooperating in research on the use of poultry manure on rangeland, a relatively low-value crop on which little manure has been used.

Also on the Riverside Campus we have underway a comprehensive program of research concerned with the development, screening, and field trial of chemicals for pest and insect control. We have an intensifying program in the area of biological control. We eventually will be able to develop integrated programs of chemical and biological control in relation to sanitary measures. A new emphasis on the biology of flies, gnats, and mosquitoes has been undertaken by various research departments of the University.

At the Davis Campus, a research engineer is concerned with basic problems of manure management. This research engineer, supported by a public health grant, will continue to devote much of his time to farm

The Agricultural Extension Service has assigned an engineer to work with farm advisors, local organizations, and operators in the engineering phases of sanitation problems. Two technicians assist the Extension entomologists in carrying on their routine work, so that the specialists may devote more attention to the problem. At least 15 poultry farm advisors give from 10 to 35 percent of their time to the problem of fly control and manure management. Four animal husbandry farm advisors devote a considerable portion of their time to the livestock sanitation problem. There is a growing demand for assistance from dairymen.

The Extension Service specialists in animal husbandry, poultry husbandry, and dairy integrate sanitation into their regular programs of work. The Extension Service employs an animal parasitologist who devotes the major portion of his time to coordinating and developing an organized Statewide program of field research, demonstrations, tests, and service, in cooperation with other Division of Agricultural Science personnel.

A revision of a dairy circular places emphasis on sanitation, with the use of chemicals as a complementary and supporting means of control. The first of a planned series of 20 or more leaflets on animal manure management and sanitation has been issued. The first leaflet is

"Poultry Manure Management."

A few examples show how this sanitation problem is being met in California. Orange County has a particularly acute problem with poultry. The county has experienced a population increase of 37 percent during the past 3 years. The congestion of people in poultry-producing areas has brought about problems that concern the county supervisors, the county health department, poultry association, Extension Service, and citizens in general. The county health officer has appointed an advisory committee consisting of representatives from the U.S. Department of Public Health, the University of California, and the California Department of Public Health to work with the Orange County Health Department and develop agency cooperation. The work underway emphasizes sanitation and control of flies.

In Ventura County, the owner of a new poultry development for 70,000 birds has constructed screened housing which competely encloses the operation. A farm advisor works closely with the management in working out remaining problems. In this same county, another poultry operator gave the University a scholarship for research with the lesser housefly. A member of the staff, taking advantage of this scholarship, is now at Ohio State University. His field work will be completed upon his return.

In San Bernardino County, the county health department and the Extension Service are exploring the possibilities of effective cooperation with the poultry and dairy operators in that county.

California's feedlot industry has grown tremendously during the past few years. Approximately 25 percent of the feedlot capacity in the State is in the Imperial Valley. At least 90 percent of the economy of that area is agricultural.

At present, an economic study is underway to show the contributions of the feedlot industry to the economy of the county. This study should stimulate community-wide interest in working toward solutions.

In Los Angeles County, two feedlots located near Pomona were the sources of odors that became so irritating that lawsuits were filed. The livestock farm advisor conceived the idea of a "smell panel." He selected people in surrounding urban areas to sniff the air systematically and record reactions in accordance with a schedule he devised. They determined the time of day the odors were troublesome. With experience, they distinguished between odors and recognized those from petroleum, smog, garbage dumps, and other sources. The advisor meanwhile worked with the operators on a cleanout and manure management program. After a time, the panel observed a decrease in the feedlot odors and the problem grew less acute.

Following this, an agreement for Los Angeles County operators of feedlots was worked out with the help of many groups. It describes what shall be done to hold down odors. It also provides for inspection by a representative of the County Livestock Commissioner's office. Lawsuits were dropped, and an ordinance which would straitjacket all of the feedlots of the county was avoided.

Tulare County trials with the crowding of cattle have developed useful information. In that county an outstanding demonstration of swine raising under relatively sanitary conditions also has attracted much interest. A local farm advisor and the University Department of Agricultural Engineering cooperated

There are now many dairies and poultry farms throughout the State with lagoons for the disposal of manure. Operators are receiving information about the wise use of this manure on their cropped fields.

What have been the results of 3 years of coordinated effort?

1. Development of an organized program has tended to slow up lawsuits, ordinances, and difficult restrictions. Ordinances are a necessary part of the community approach, but a part only. These should provide a general basis for operation and a guide for meeting situations. They should follow careful study by a community-minded group.

2. Research covering a wide range of the problems is underway. Some of it is being done by the University alone; some involves agency cooperation; some of it is carried on directly with organized community groups.

3. Applied research in local situations steadily gains momentum.

4. There is a notable change in attitude among people, particularly on the part of farmers. Some farmers are finding, apart from urbanization, that it is well to improve their own living environment and comfort and also the health and welfare of their livestock.

When we undertook this work 3 years ago much had been done, but it had been piecemeal. Some of it was expedient and not part of organized effort. Today, organization is developing; agencies are learning; communities are recognizing their responsibilities and gaps in information are being closed. ■

Kansas Materials-Handling Program

by JOHN M. FERGUSON, *State Leader, Kansas Extension Engineers*
and E. CLIFFORD MANRY, *Pawnee County Agricultural Agent, Kansas*

THIS program was and is Extension's answer to a problem facing many Kansas farm producers. The economic situation relative to farm production and prices has made efficient and economical farm operation a must if the manager is to stay in business and earn a satisfactory income.

Many producers also want to reduce the physical labor, "common work," associated with the handling of grains and livestock feeds in the process. When you add the impact of developments such as (1) the continued increase in size or volume of farm businesses, (2) a shortage of qualified labor for hire on farms, (3) increased wage rates for farm labor, (4) the availability of "high line" electricity on 98 percent of the farms, and (5) the rapid development and increasing availability of mechanical equipment designed and adapted to farm use, you have a situation calling for action.

Kansas Extension engineers, county agricultural agents, and farm leaders were alert to the situation. In 1958 they began planning and conducting their educational program of increased emphasis on farm material handling in the grain and livestock feed, storage, processing, handling, and feeding areas.

The primary objective of the program is the development of efficient, economically justified systems for handling grains and livestock feed on the farm. Equal emphasis is placed on efficient systems and economic justification. We feel the program has been effective. A survey to all county agricultural agents last fall (1963), 5 years after initiation of the program, reveals we now have in operation recommended systems or potential demonstration units in nearly every area of the State and for all major production programs.

The teaching methods and techniques have been adjusted to most effectively teach the audience being reached at any time. It is a coordinated effort between county Extension staffs and farm leaders, Extension agricultural engineering specialists, resident agricultural engineering department staff members, representatives of the materials-handling equipment manufacturing industry, and the rural power suppliers of Kansas.

County agricultural agents assumed major responsibility in planning for publicizing and conducting the program on a county basis, and Extension agricultural engineers, Leo T. Wendling, Harold E. Stover, and John A. True for subject-matter preparation and presentation at county events.

Initiation

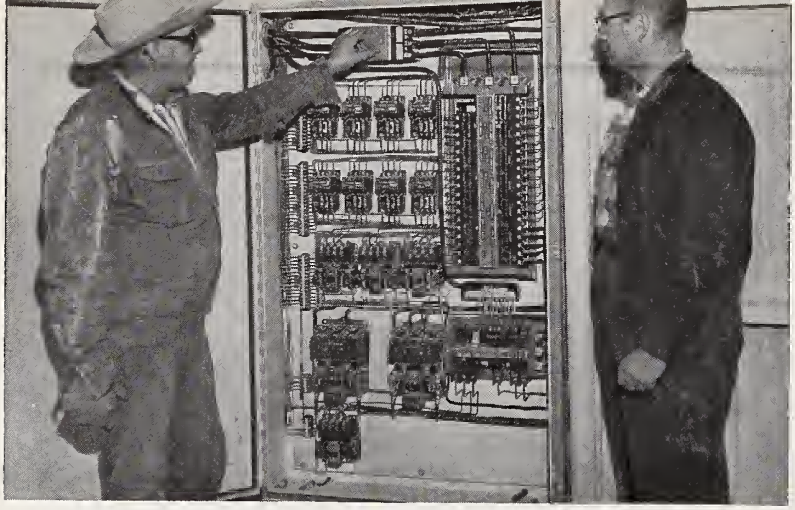
To initiate action in most counties, public meetings were planned. The purposes of these meetings were as follows.

1. To let the public know the Extension Service was prepared and capable of providing educational information on the development of farm feed-handling systems.
2. To stimulate interest in the development of efficient, economical, on-the-farm feeding and feed-handling systems.
3. To emphasize the importance of planning a complete system prior to construction or equipment selection from both the economic and efficiency viewpoints.

In some instances the public meeting was a correlated meeting with other production specialists. In other counties it was a special meeting on materials handling and livestock production plant layout only. These meetings were effective in getting many producers to think before acting—the first step to a successful plan.

It soon was evident to Extension engineers and county agricultural agents that the average farm producer needed some personal, professional help. In general this type of help was not readily available in

Left, the storage and processing center developed by Mr. Ohnmacht. Right, using mixer distribution wagon.



Mr. Paul Ohnmacht and Pawnee County Agricultural Agent Clifford Manry examine electric control panel.

Kansas. The established engineering firms generally involved in feed storage and design of processing systems were busy with the larger commercial operations. Some equipment manufacturers supplied limited engineering services, but many were primarily sales-oriented and gave little attention to system engineering. To bridge this gap, a training program was developed for county agricultural agents.

The first step in this program was the development of a handbook, *Planning Feed-Handling Systems.* This handbook gave many thumb-rule guides and general information on planning systems, equipment selection, and power and controls in the system. In addition, engineering specialists assembled and bound sets of equipment manufacturers brochures giving specifications on their equipment. Both the handbook and the assembled brochures were supplied to each county agent for reference.

The second phase of the agent training program was a series of 2-day workshops where interested county agricultural agents planned layouts and systems to fit specific conditions under the supervision of specialists. While these workshops did not make engineers out of the agents, they did enable them to function efficiently as personal advisors to local farmers. Approximately 70 percent of the Kansas agricultural agents participated in this training over a 2-year period.

The county Extension agents found that a number of their cooperators needed specific assistance on their feed-handling problems. They had gone through Extension's educational program and were now ready for the detailed planning and construction phases.

Workshop

In 1962 and 1963 a series of special workshops was planned. They were purposely designed to assist those cooperators who were asking the county agent for specific installation planning. The workshops were worked out to assist the cooperators in following through a sequence of training steps as needed to develop a feed-handling system for their specific livestock program.

A series of three workshops was conducted in each of eight different areas of the State. The monthly workshops in each area were limited to three or four cooperators from each county with four to six counties participating in each workshop.

Each county was invited to enroll in the program on the basis of a survey of interest and need. Each county agent who participated in the program selected his own three to four cooperators. His selection priority was based upon cooperators who indicated a willingness and desire to attend the entire series and those who were planning to install a feed-handling system in the near future.

The first training session of each workshop consisted of a discussion and a question-and-answer period by three different engineering specialists on (1) livestock and feed storage and handling facilities; (2) machinery needed in a feed-handling system including augers, elevators, grinders, and feed wagon; and (3) electric motors, automatic controls, and wiring requirements.

The second and third training sessions were devoted to actual planning and recording on paper with a drawing showing all the detailed parts of the feed-handling system that would be needed.

The final session also included an estimated cost of the planned installation. The engineering specialists who conducted this program were in the fields of farm structures, farm machinery, and farm electrification. They acted as consultants and technical advisors to the cooperators.

Through this specialized training program over 100 farm operators were given personal assistance in planning and installing many types of feed-handling systems.

An operating system

Today many of the cooperators who received training at the workshops now have successful systems in operation. One such operator is Paul Ohnmacht of Pawnee County located in the southwestern part of the State. Ohnmacht operates a farm of approximately 1,500 acres, some of which is irrigated.

His livestock program consists of a 200-head Angus cow herd and in addition, Ohnmacht full-feeds about 1,200 head of beef steers or heifers per year.

The feed-handling system and lots being used to store, process, and handle feed for this program consists of:

1. two 20′x60′ upright concrete stave silos,
2. six overhead storage bins over driveway with 5000 bu. capacity,
3. two hold bins over roller mill, with 1,100 bu. capacity.
4. two hopper-bottom metal bins outside the main building with 1,000 bu. capacity each.

The overall size of storage and processing building is 28′x 48′.

The processing phase of his materials-handling system follows:

1. Feed is processed through a 10″ roller mill with 350 bu/hr. capacity using a 10 HP electric motor.

2. Feed is distributed with a mixer distribution feed wagon.

3. A 22′ platform scale is used for measuring all ingredients.

4. The heart of his conveying system is a 70′, 1,200 bu/hr. bucket elevator, powered with a 5 HP electric motor. This elevator leg is supplied from a 6′ deep dump pit with a horizontal auger.

5. The feed is distributed through a 12-hole distributor head.

6. The silage is removed from the upright silos with a silo unloader that is transferred from one silo to the other when needed.

7. The processing center is supplied with 200 ampere three-phase electric service which is distributed through a central electric control panel. For standby electric power service, Ohnmacht has a 15 kw tractor-powered generator.

County agent Manry reports the approximate cost of the processing, handling, and storage center, less the two silos, at approximately $31,000.

The feedlot, corral, fencing and 480 ft. of fence line bunk with 8 ft. slab is estimated at $5,000.

Prior to establishing this feed-handling system in November 1963, Ohnmacht had been feeding about 300 head of cattle. At present he is feeding 500 head in one hour per day. He processes about 1,000 bushels of grain sorghum per week plus 2 tons of protein. He can load 1½ tons of silage and 1½ tons of grain into the feed wagon in about 20 minutes with the system.

Exhibits and demonstrations

At the invitation of the Board of Managers of the Kansas State Fair, the Departments of Extension and Agricultural Engineering built a model feed-handling system and exhibited it at the 1962 Fair in Hutchinson.

This exhibit was an operative working unit and represented a complete electrically-operated farm feed storage and processing system. The equipment was supplied on a consignment basis from the manufacturers of the various units. It is now used in the research lab of the Department of Agricultural Engineering.

Metal tanks were used for grain storage, supplement storage, and ground feed storage. The primary feed-handling unit was a vertical cup elevator. Horizontal flow was by gravity spouts where possible, with augers for secondary movement. Processing included grinding with a roller mill, mixing with a horizontal mixer, and measuring with a platform scale. The entire system was electrically controlled from a central control panel with dustproof light indicator pushbutton switches, magnetic controls, and individual circuit disconnect switches for each motor.

In addition to the operating system, four small scale model layouts were designed and built to illustrate how the system could be used on a beef, dairy, swine, or poultry farming program.

During the State Fair it was estimated that 5,300 different individuals observed the demonstration.

The Departments of Agricultural Engineering, Engineering Extension, and the manufacturers of feed storage and handling equipment have cooperated on conducting an exhibit and educational program at KSU each spring for the past 4 years. This popular program has received wide publicity. Each year 3,500 to 5,000 Kansas farm operators view new equipment and learn of their application through this special on-campus event.

Observation

Many of the planned and completed systems such as Ohnmacht's are now serving the county Extension program as good demonstrations of planned feed-handling systems. Many of these demonstrations are being used as stops on correlated tours with livestock production specialists and special interest feed-handling tours. ■

The Model Feed-Handing System as demonstrated at the 1962 Kansas State Fair. This system is now being used for research at Kansas State University.

Environmental Control

by DALTON S. HARRISON, Ass
and JACK T.

Low winter temperatures have been a problem for citrus growers in Florida ever since citrus was introduced in the State. Florida growers long ago passed up soil fertility in favor of warmer locations.

The age-old practice of heating groves for cold protection, though not practiced widely before 1957, is being used more extensively in Florida today than ever before. Probably one-third of Florida's 735,200 acres are currently under some type of frost protection. Even with the most modern means we have—wood, coke, gas and oil heaters, and wind machines—protection from minimum temperatures is still uncertain and expensive.

In this report we hope to show Extension's role in the dissemination of information about a newly-introduced method of environmental control for citrus—irrigation for cold protection.

Who started it?

The method of adding water to low growing crops and mature trees as a means of "frost protection" has been known to Extension and research workers and other well-informed persons for a number of years. The idea of using water on Florida citrus for *cold* protection, however, sprang from nowhere in the fall of 1962 and stirred interest in every corner. Reports from commercial irrigation concerns and growers in California and Michigan about the successful use of water for cold protection figuratively raised the eyebrows of growers who were already looking for a better and cheaper means of cold protection. Thus, the call to Extension for more information skyrocketed. Rumors ran rampant and many Florida growers were saying: "If it works in California surely it will work in Florida, so tell us what to do." In the meantime; commercial irrigation concerns in Florida, encouraged by their counterparts in California, Michigan, and abroad; began to install (at inflated prices) irrigation systems for freeze protection of citrus.

Since requests for more information continued, we set about searching the literature and prepared a report on "irrigation for *frost* protection." When this was completed we gave a verbal report at one of our citrus growers institutes. The information available showed that irrigation at a 1/10 inch-per-hour rate would not be successful against windborne freezes and very low temperatures. This we underlined in our report, as well as on every occasion we spoke to growers. Nevertheless, growers continued to install systems until some 4,000 acres were covered.

Realizing this was a new concept and fearing that our growers were making a mistake, the next step in our program was to see if we could get some research started immediately. Working closely with research associates, we were able to get an affirmation of their willingness to do an emergency study. Since no funds for the study were available, we contacted commercial concerns interested in this phase of cold protection and asked them to contribute materials for such a project. The response was gratifying and a system was installed on the University of Florida campus. It was completed only a few days before the 1962 freeze.

On the nights of December 12 and 13, 1962 Florida had what has been termed "the freeze of the century." Temperatures plunged to 15°F. in Gainesville and 19°F. in the heart of the citrus belt some 140 miles south of Gainesville. This shattered all hope of favorable results. The results provided an even more dramatic answer. The extremely low temperatures stopped installation of these irrigation systems on thousands of acres — installations which undoubtedly would have taken place had we not received these low temperatures and negative results until some years later.

A survey after the freeze showed over 4,000 acres almost completely destroyed as the result of using a system that applied too little water. Fingers were pointed in many directions and we may never know the persons or factors directly responsible for this mass movement into an untested area.

During a few short weeks, Extension workers kept close watch on research work taking place during and immediately following the freeze. Researchers scanned every piece of data, considered information from other States and foreign countries and came to this conclusion: we were attempting to use insufficient water for *cold* protection. Also there were areas in design wherein systems must be improved.

The few isolated instances where growers used larger rates of water substantiated these research findings. For

The "freeze of the century" plunged temperatures to 19°F. in the heart of the citrus belt.

Citrus in the Grove

Extension Engineer, University of Florida
OWN, *Polk County Agent, Bartow, Florida*

the first time we could give recommendations with reasonable certainty, based on research under Florida conditions. The use of overhead sprinkler systems for cold protection in citrus is hazardous. If employed, a system of more closely-spaced risers and larger volumes of water than originally planned, must be used. Extension, with an unscheduled assist from the century's worst freeze, has succeeded in changing this incorrect use of irrigation for cold protection.

Frost warning projects

The minimum temperature experienced in Polk County during the 1962 freeze, resulted in serious damage to a large percentage of the county's 134,000 acres of citrus trees. Following the freeze and under the guidance of the Polk County Citrus Advisory Committee, immediate steps were taken to adjust the county's Extension education program to that of "rehabilitation of the freeze-damaged trees." Educational information and activities concerning horticultural practices, rehabilitation financing, grove-management programs, and demonstrations of pruning damaged trees, were immediately available to growers in the county. This "crash program" received excellent response and groves were recovering satisfactorily by the fall of 1963.

The approaching 1963 winter, of course, alarmed growers who feared another freeze. They knew damaged trees could not withstand low tempratures without being damaged further or killed. This brought questions as to what temperatures and under what conditions should protection procedures be initiated.

The availability of immediate weather information and frost warning bulletins to growers appeared vitally important to the continuance of the tree rehabilitation program. With the assistance of the Federal-State Frost Warning Service and the Board of County Commissioners, a project was initiated by the Polk County Agricultural Extension office to help growers obtain weather information during periods when critically low temperatures were expected. Via weather teletype service from the Federal Frost Warning Service, the county Extension office received continuous 24-hour weather information and frost warning bulletins. On nights when critically low temperatures were expected, current temperature bulletins were relayed from the county Extension office to the five County Commissioners' District offices located in different areas of the county. Growers were able to obtain, by local telephone, vital temperature information and current forecasts. These had been previously quite difficult to obtain due to the inability of the frost warning service to handle all telephone calls and also because local radio stations do not operate on a 24-hour basis.

This project received grower acclaim far beyond expectation. Although a serious freeze did not materialize, several nights of dangerously low temperatures did occur. On these nights the frost warning project proved quite effective in disseminating vital information.

Progress to rehabilitate Polk County's freeze damaged citrus trees, has been directly influenced by the county Extension program. Without further freeze damage, Polk's citrus trees will recover to the point where production will increase rapidly during the next few years.

Present status of environmental control

One winter has passed since the 1962 freeze struck a death blow to many of Florida's citrus trees. Few growers had ever experienced such a severe setback in their efforts to develop citrus groves. And in order to eliminate repetition of the 1962 disaster, more citrus acres than ever before were provided some means of cold protection during the 1963-64 winter. Not only were more acres of citrus provided protection, but also more types of cold protection devices were available to growers than ever before.

Although we now have effective ways of protecting citrus trees during freezing temperatures, cold protection is an expensive grove operation. In years ahead the Florida citrus grower will look to research and the Agricultural Extension Service for development and demonstration of more effective and efficient means of protecting his citrus trees. ■

Extension-Industry Teamwork

by E. A. OLSON, *Extension Agricultural Engineer, Nebraska*

THE EXTENSION SPECIALIST and the football coach have some things in common. Both must give careful attention to selecting or recruiting the members of his team. If either has all positions except one, or if he cannot find a capable and determined player to fill a key position, his chances for a winning team are greatly reduced.

We used this team approach to get farmers to accept crop drying in Nebraska. Our team included the farmer, researcher, Extension, and industry (the manufacturer, distributor, dealer, and power supplier).

Several things happened in the Cornhusker State in the mid-forties that created a need for crop drying. For a number of years farmers had struggled with the problem of soft corn caused by early frost. Stored wheat developed a "sick" condition, caused by too much moisture. Field picking and shelling of corn was being delayed at this time because the shelled corn was too wet for storage. Too much moisture was the problem. The remedy was simple: reduce the moisture by drying grain in storage.

Research has been done by our Agricultural Engineering Department which showed that grain could be dried in existing storage bins. To get this idea accepted, farm drying demonstrations were started in 1949. Several team members were needed.

The first "recruits" were our county Extension agents. They were advised of the needs, methods, and values of crop drying on the farm. Agents then selected several farmers who were eager to pioneer grain-drying systems on their farms.

To acquaint our county agents with crop drying, a series of training meetings was held at which the need for farm crop drying was explained and the techniques were demonstrated. Agronomy specialists assisted with the program by taking part in these meetings. At first some agents questioned the need for this "new" practice, but after observing high field crop losses because of delayed harvesting, agents soon saw the potential of this new practice.

Equipment, the "fullback" on our team, was needed for demonstrations: Blowers, electric motors, and air distribution systems. Several manufacturers of crop-drying fans were contacted, and after learning of the potential future of the program, several agreed to join our team by loaning equipment. Several kinds of equipment were used, giving us an opportunity to get acquainted with the different blowers. Our team continued to take shape with the manufacturers of grain bins providing several air distribution systems for installation in farm grain storages.

Electric power suppliers were also recruited. As "halfbacks" they provided electric motors for running the crop-drying fans. They also made several blower and motor units for demonstrations.

Through the team effort, 19 farm crop-drying demonstrations were set up in 1949. These provided us with valuable operating and design information as well as costs. With the help of research personnel more specific recommendations were prepared and publicized.

As farm interest developed, agents organized local meetings to explain the why, how, and cost of crop drying. A survey in late 1950 showed that farm acceptance was faster than expected. Crop-drying facilities were being used by 132 farmers 1 year after the team had been recruited.

As interest developed in drying and the demand for equipment grew, several local small manufacturers became interested in building these units. To present the latest research information and design requirements to manufacturers a crop-drying short course was held in 1951. This session was enthusiastically attended by some 50 manufacturers, dealers, and others interested in crop-drying equipment. This established an engineering basis from which manufacturers, dealers, power suppliers, and others could start to operate. As a result of this meeting, better equipment soon appeared on the market.

Crop drying was adopted on more farms in the fifties. More farm demonstrations and meetings were held, news articles were prepared and a second series of agent training meetings was held in early 1958. A crop-drying handbook for manufacturers and farmers was also developed.

New information on drying techniques became available, but because there were differences of opinion on the correct applications, another meeting including national crop-drying manufacturers was needed. A second conference was held in 1958 with practically all manufacturers in the United States attending to get the latest information available. As a result, more and better crop-drying equipment is being built by the manufacturer to more adequately serve the farmer's needs.

Teamwork has been the key to rapid adoption of crop drying on Nebraska farms. Each of the groups mentioned—county agents, crop-drying equipment manufacturers, grain storage manufacturers, and local electric power suppliers have been an important part of our team. While no data are available on the number of farms with crop-drying equipment, manufacturers have advised us that it has had its most rapid growth in the Cornhusker State.

We believe that we in Extension are in the unique position of the "quarterback" on many new practices. When we miss on some plays, maybe we are not calling on the right member of our team at the right time. Industry is an important and eager member, and when recruited, trained, and played we all can win. ■

A 40'x 400' broiler house utilizing conventional construction and natural ventilation. The building incorporates continuous ridge vents with continuous floor level ventilation and makes use of adjustable sidewall curtains.

Modified Environment Poultry Housing

Arkansas Extension provides producers with basic information on how to get the best results from insulation and fan-ventilated houses.

by R. C. BENZ, *Extension Agricultural Engineer* and R. H. JOHNSON, *Extension Poultryman, Arkansas*

ARKANSAS currently ranks second in the Nation in the number of broilers produced. With the rapid expansion in broiler production came the need for more broiler houses. In many cases substandard housing was constructed in an effort to build production facilities at a low cost. Basic construction principles were overlooked and many houses were constructed on a trial-and-error basis. Problems of ventilation, wet litter, and inside temperature fluctuation during the winter were accepted by the producer.

During the past 2 years broiler growers have devoted increased attention to these housing problems. Efforts are being made to solve them by controlling or modifying the environment within the house. This means the use of insulation, ventilation, and supplemental heat. Modified environment would describe the type housing being considered because completely controlled environments are extremely difficult to achieve.

Early housing

Askansas' production began expanding after World War II, birds were housed in small, narrow houses. As poultrymen increased the capacity of their production facilities, they began to build wider and longer houses and relied entirely on natural ventilation.

These houses were constructed as inexpensively as possible. They usu-

Insulation is being applied in the roof section during initial construction of the house. A plastic vapor barrier was used and fiberous-type insulation material was installed between the nailing girts beneath the roofing.

This broiler house has adjustable sidewall curtains. It incorporates natural ventilation in summer and winter.

ally incorporated floor, window level, and continuous ridge-vent openings. The operator made manual ventilation adjustments depending upon the weather and wind currents. These houses were succeessful for summer production, but problems were encountered with wet litter, wide inside temperature fluctuations, and inability to adequately close the ventilation openings in the winter.-

When mandatory poultry inspection began in January 1959, producers felt that poultry condemnation during the winter months resulted partially from improper housing. Some producers began to take a new look at improved, redesigned poultry houses which promised reduced condemnation, increased feed conversion, decreased poultry health problems, elmination of wet litter problems, and reduced manual labor requirements in management of the poultry house.

Since 1959, popular press releases have referred to *controlled environment, modified environment,* or *insulated fan-ventilated* poultry houses as answers to some of the housing problems. New materials have been widely advertised for use in poultry housing, and many advantages have been cited for improved environment for poultry. All of these have left the poultryman somewhat confused as to the most desirable type of housing for poultry production in Arkansas today.

With a narrow profit margin in poultry production and the increase in contract farming with vertically integrated companies, the poultry grower asks these questions:

1. How much can I afford to spend on poultry housing?

2. What can I expect in return for the extra investment in insulation, fans, and heating equipment required for modified environment?

3. How do I select insulation materials, fans, and heating equipment?

4. What are the ventilation requirements and operating procedures for a modified environment house?

Many extremes in insulation and mechanical ventilation were tried in new and existing poultry houses. Much was learned and many dollars were spent in trying to find answers to some of the questions which arose as the idea of modified environment progressed. It is necessary to point out that research was also being conducted by some colleges and the USDA. Due to the expense of poultry housing research, answers to these problems have been difficult to obtain. However, some basic information has been provided, and as research is continued, additional problems will be solved. Some members of the poultry industry are continuing to conduct field trials in an effort to determine solutions to some of the remaining housing problems.

Extension found itself confronted with questions concerning environment-controlled housing which could not be answered based on research findings. In an effort to provide some information the Extension poultrymen and the agricultural engineers worked with industry personnel to modify existing houses and observe various modified environmental systems in the field.

From this work and available research, some answers were provided to Extension agents. Field observations showed a lack of information among poultrymen about the type, amount, and application of insulation. In many cases insufficient amounts of insulation were being used and the desired results were not obtained. Fiberous type insulation was being used, but without an adequate vapor barrier to protect the insulation material.

In other cases, no protection was provided against mechanical damage. Also, Polystyrene material of in-

sufficient thickness for reducing the desired heat flow was used in existing buildings. Under such conditions the heat loss was excessive, and it became impractical to maintain the desired inside temperatures and ventilation rates. Many of these problems were caused by producers attempting to apply insulation at a minimum cost.

Throughout the industry the application of insulation material is a problem caused by random spacing of structural members when the building was erected. No thought was given during construction to designing the building for the addition of insulation material at a later date.

Where houses were properly insulated, difficulty was sometimes encountered in maintaining proper ventilation. Most of these houses still relied on natural ventilation and had problems with Ammonia and wet litter. In other instances litter became too dry and dust created difficulty. Most of these problems were related to rates of ventilation and amounts of supplemental heat used. This is still a problem because of untrained management and lack of satisfactory control systems to provide variable rates of ventilation dependent on weather and age and type of birds.

In summer, lack of ventilation can be a major problem with the insulated houses. Houses that give satisfactory results in winter may lack sufficient, fan capacity for summer ventilation. In some cases, where fan capacity is available, the fans are not properly utilized due to a lack of knowledge concerning air movement. Supplementary ventilation openings must be provided for summer use in many instances. During summer months fans are now used to stir air while sidewall vents are open to take advantage of natural ventilation.

Some misunderstandings are still observed among producers. For instance, they mistakingly feel that an insulated house will have a cooler air temperature inside as compared to the outside, that any amount of insulation material will improve the performance of the birds, and that use of fans is not important.

Extension educational program

With these points in mind, efforts were made to provide basic information about insulation, fans, and their application in poultry housing. Emphasis was placed on teaching that all insulation materials can be evaluated by their resistance to heat flow. But producers should also keep in mind the cost of the material and its application.

Slides and charts have been developed for teaching structural design and basic consideration of insulation in poultry housing. Fundamentals—such as the need for and application of a vapor barrier, as well as protection of insulation from mechanical damage—are stressed.

Statewide meetings also were held to acquaint industry leaders with the information available through the Agricultural Extension Service.

Extension agents are conducting area training sessions with the assistance of the Extension agricultural engineer and the Extension poultryman, when requested. These efforts have been well received by industry. And many producers are giving more consideration to the types and amounts of insulation used as well as evaluating methods and control systems for ventilating modified poultry houses.

The basic outline of the Extension approach to modified environment poultry housing has been to provide basic information on how to obtain the best results possible from insulation and fan-ventilated houses through the sound application of environment control principles.

This information is developed to help the poultryman decide how to modify his poultry houses and whether such modification is economically feasible. ■

This insulated fan-ventilated house incorporates 3⅝" fiberous-type insulation in the roof protected with a plastic vapor barrier and ⅜" plywood. Sidewalls have plastic vapor barrier, plywood for mechanical protection, and 2" fiberous-type insulation material. The ventilation is provided by fans operated by time clocks.

Training Power-Use Advisors For Action Programs

by E. T. SWINK, *Head*
Agricultural Engineering Department
Virginia Polytechnic Institute

ONE OF THE major functions of the Agricultural Extension Service is that of conducting educational programs on new practices that will enable farmers to produce more efficiently and profitably. The usual yardstick for measuring the effectiveness of such programs is the extent to which farmers adopt and benefit from the new practices assumming that the new practice will be of value to the farmer and that he is ready to adopt it, at least two important conditions must be met before it can become a reality for him. First, the materials or equipment that are required must be readily available and second, someone must use accurate know-how in selecting, installing, applying and using the materials or equipment under the conditions that exist on the farm.

In developing plans for educational programs on environmental control in poultry houses and on materials-handling systems for farms in Virginia, the Extension specialists recognized the importance of satisfying these two conditions.

Unfortunately, it is usually not possible for a farmer to go to an equipment supplier and purchase over the counter, a "packaged unit" materials-handling system or an environmental control system for an existing farmstead or building. At best, a good supplier might be able to provide all of the required component parts for such a system. The first problem confronting the purchaser, as well as the equipment supplier, is that of determining what components will be required in a system to meet the specific needs on the farm in question.

Solving this problem involves engineering knowledge. In most cases, neither the purchaser nor the dealer can be expected to have, or to acquire, the amount of engineering knowledge that is necessary to solve this problem. Since private consulting agricultural engineers are not yet generally available in Virginia, and there is a limit to the amount of engineering assistance that can be provided by Extension specialists, it is necessary for farmers to seek technical help from other sources.

From the very beginning of the rural electrification movement in Virginia more than 35 years ago, the power suppliers have been encouraged to employ agricultural engineers to assist their customers with power use problems. Fortunately, practically all of Virginia's power suppliers that serve rural areas have personnel to provide this kind of service. Most of these people are agricultural engineers with sound basic training in electric power and its utilization in agriculture. Intensive short courses have been arranged by Extension agricultural engineers as needed, to keep these power-use advisors up to date on subject-matter information pertinent to their work in farm electrification.

By spring of 1961, research and observations on several field installations showed that modified environmental control in poultry buildings was a sound practice for Virginia poultrymen. The agencies and organizations represented in the Virginia Farm and Home Electrification Council decided that a Statewide educational program on this practice should be developed. The first step in such a program was that of providing up-to-date training for the people who would be expected to be the technical experts and educational leaders in the program. Involved in the training would be power-use advisors (power suppliers); representatives of the manufacturers and distributors of fans, controls and insulating materials and key leaders from educational agencies. Extension specialists in agricultural engineering, agriculture economics, and poultry science planned an intensive, 2-day short course for these groups to:

(1) Provide information on minimum requirements

for the proper and practical control of environment in poultry houses.

(2) Bring about more uniform recommendations and a better understanding of poultry house construction and ventilation details.

(3) Encourage those in attendance to assist poultrymen in solving poultry house construction and ventilation problems.

To achieve these goals, the short course agenda included the following subjects.

(1) Why are we concerned about better poultry housing? (2) The effect of environment on feed conversion, egg production, and egg quality. (3) The effect of environment on feed conversion and condemnations in broiler production. (4) Building design and construction features. (5) Basic principles in selecting and using insulating materials. (6) Pressurized, exhaust, and blended air ventilating systems. (7) Basic principles in ventilating poultry structures. (8) Methods of insulating and ventilating existing poultry structures. (9) Fans and controls for poultry house ventilating systems. (10) Types of air inlets and outlets and factors in their design and location. (11) Typical poultry house ventilation problems and suggested solutions (12) Economic considerations in providing improved environmental control in poultry structures. (13) Explanation of new plans for poultry buildings. (14) Design problems for short course students. (15) Group reports on design problems (16) Laboratory study of electrical controls for ventilation systems. (17) Short course summary and the job ahead.

The short course was held November 1-3, 1961. Participants included 27 power-use advisors, 29 equipment supplier representatives, and 19 educational leaders—a total of 75. Following this short course, four area training meetings, of 1 day duration each, were held for additional power-use advisors in different parts of the State. During March 1962, ten 1-day area production schools on poultry house environment were held for poultry producers and allied industry people. These were followed up by county Extension agents conducting the usual educational activities at the county level with the assistance of power-use advisors.

What were the results of this effort? The specialists had positive information by the end of 1962 that controlled ventilation systems had been installed in new and remodeled poultry buildings with a capacity of approximately 400,000 layers. During 1963, controlled ventilation systems were reported in new and remodeled laying houses with a capacity of 305,000 birds. It is now accepted practice to make modified controlled environment an integral part of new poultry laying houses when they are constructed. Old laying houses are rapidly being remodeled, insulated, and equipped with mechanical ventilating systems. Interest is developing rapidly in controlled ventilation for broiler houses and new buildings were so equipped for 135,000 birds in 1963. The advantages of controlled ventilation in poultry buildings are of significant economic importance. It is expected that practically all of the 6½ million birds in Virginia's commercial laying flocks will be housed in controlled ventilation buildings in the next few years.

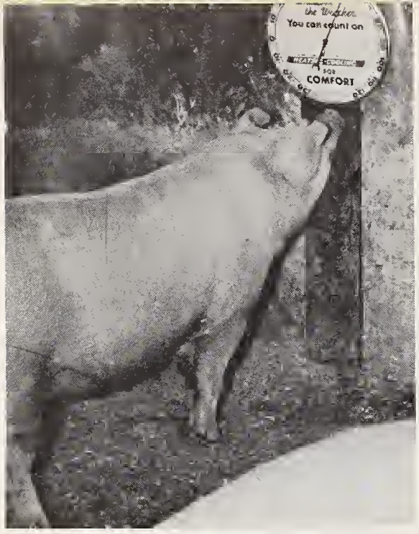
Recognizing the need for an educational program on grain handling in certain areas of the State, the council decided to initiate such a program in 1962. Here again it would be necessary to have people with up-to-date technical training available locally to assist farmers with problems in this area. The first step in the program was for the Extension agricultural engineers to arrange a 2-day intensive short course for power-use advisors, equipment suppliers, and educational leaders. The objectives of this training program were to:

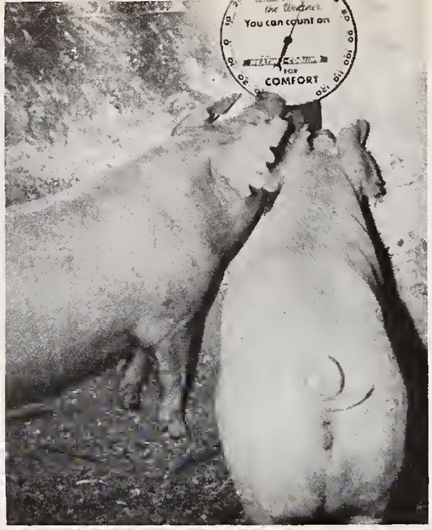
(1) develop a better understanding of the design, layout, and operation of on-the-farm grain-handling systems, (2) acquire information on the economics of grain-handling systems on farms, and (3) encourage the participants to assist farmers with grain-handling.

This short course was held November 28-30, 1962. The same guiding principles that were observed in the training program on environmental control were followed in determining the subject matter to be covered in the short course. The 65 participants included 27 power-use advisors, 10 equipment manufacturer and distributor representatives, and 28 leaders from educational agencies. This program continued to move forward with activities at the county level being carried out by county agents and power-use advisors.

To supplement the grain-handling program that was initiated in 1962, another short course for power-use advisors and others concerned with automatic and mechanical feeding systems for livestock was held November 20-22, 1963. This program of study covered the importance of mechanical feeding systems, applicable motors, motor controls and protection, electric control devices for mechanical systems, steps in planning mechanical feeding systems, efficient feeding layouts for dairy cows and swine, fitting components into a system, design problems for the participants, and economic considerations that were involved with feeding systems. A total of 60 power-use advisors, equipment suppliers, and educational leaders participated in this training.

The power-use advisors in Virginia render an extremely valuable service to the farmers and rural people of the State. Although their primary function, from the Standpoint of the power supplier is to increase the use of electric service, they are vitally interested in seeing that the farmer's use of electrical equipment increases his net return from the enterprise that is involved. Probably the most effective work that Virginia Extension specialists in agricultural engineering do is that of developing and conducting inservice training programs for power-use advisors to (1) keep them up to date on technical subject matter, and (2) make possible more uniform recommendations to farmers in solving electromation and mechanization problems. If the power-use advisor has sound technical college training to begin with, he can be kept abreast of the latest developments through short courses such as those that have been described here. Certainly the current action programs on environmental control and materials handling in Virginia would not be possible without their fine support and participation. ■





by D. G. JEDELE
Extension Agricultural Engineer
Illinois

Environment Control in Swine Production

■ Farmers laugh when I show them the picture of a hog looking at a thermometer registering a comfortable 60°F. They laugh more when I show them two hogs looking at the thermometer. Then I tell them that the first pig called her friend over to see how nice and warm it was. Dr. T. E. Hazen of Iowa State University took these clever pictures several years ago, and I am grateful to him for letting me have copies.

I think of environmental control in hog housing as control of temperature, moisture, odor, drafts, and dust. Research projects have measured heat and moisture production of hogs. Basic relationships of temperatures and relative-humidity are readily calculated by engineers. Insulation values of various materials have been published in handbooks. Environmental control should, therefore, be a simple matter of design, and it could be if it did not have to be done economically. But before investing money for this purpose farmers want to know, "Will it pay?"

Why control environment for hogs?

Some form of environmental control in farrowing houses is already well established. A 1960 survey in Illinois showed that 45.7 percent of the producers had central farrowing houses. The successful ones were insulated and fan-ventilated. All used supplemental heat from heat lamps, floor heat, space heaters, or all three.

Starting buildings, or nurseries, usually provide some means of control over the environment. It is not difficult to convince producers that young pigs need protection. But controlled-environment buildings for finishing hogs is another story.

The usual advantages given for enclosed, insulated, and fan-ventilated buildings over "cold" housing for finishing hogs are: (1) better feed efficiency, (2) higher daily gains, (3) leaner carcasses, and (4) less labor.

Some laboratory research has shown that hogs finished at 60°F. gain faster on less feed than hogs finished at higher or lower temperatures. Unfortunately, the traditional corn-hog States don't have perpetual winter, when temperature is most easily controlled. When comparisons are run for typical buildings and groups of hogs in normally fluctuating temperatures, the feed-saving advantage is not so readily apparent.

Tests made by both Purdue University (1963 Swine Day Report) and Iowa State University credit warm buildings with having helped to produce a leaner hog. But better breeding and better feeding must also have some of the credit for improving carcass quality. The part attributable to the building is hard to measure. Besides, most farmers don't sell on a grade and yield basis, so it is difficult to convince them that controlled environment is profitable on the basis of carcass improvement.

This leaves labor-saving as the only real economic justification for controlled-environment hog housing. Here we are handicapped again by not having much research evidence. Everyone "sort of knows" he can handle more hogs easier in a well-designed controlled-environment building, but actual time-and-motion test results are limited. Purdue University in its 1963 Swine Day Report shows that the labor in an enclosed, partially slotted-floor building was only 54 percent of that required in an open-front building with concrete lot. If such results can be repeated time after time, we will honestly be able to say that the controlled-environment building with partially slotted floors will pay for itself.

In the meantime, farmers are building this type of building for their own reasons. Although many could not be assigned a dollar value, they are still economic reasons.

An Iroquois County swine producer told a 1963 Illinois Swine Day audience that the enclosed building permitted him to be a better manager. He had both types of finishing buildings one winter, and he found himself shivering as he chipped ice out of the waterers and shoveled manure from the open-front building. In the warm building with automatic feeding and cleaning, he had time to study his pigs.

A Tazewell County producer changed from pasture to controlled-environment confinement to expand his business without buying more land, in order to keep his aging father in business a few more years. Dad was no longer able to crawl on his hands and knees in A-frame pasture houses, but the son realized that his father's management ability was worth more than the strong back and legs of a man he might hire.

In Logan County, a producer wants his son to return to the family farm after college. A change from pasture to controlled-environment housing is permitting an expansion in his operation and a reduction in drudgery that will attract the young man to become a partner in the business. The new facilities have already made it possible to increase from 1,500 to 3,000 hogs with the same labor force.

Still another farmer found through his farm management records that he consistently made his highest profits on hogs, so he now rents out his cropland and spends full time managing a greatly expanded swine business on a small acreage in controlled-environment buildings.

These are the innovators and community leaders, but local leaders are already building new swine buildings copied from those of the innovators. The danger is not so much that these buildings might not prove economically justifiable, but that in an effort to reduce costs, the farmer might overlook an important feature that will keep the building from functioning properly. The Extension engineer's job is partly to justify the building, but mostly to educate farmers and builders in the engineering details so that the building will not fall short of operating successfully. We have all been involved in cases where lack of attention to details has caused something to be so near to and yet so far from success.

How to teach environment control

The main ingredients for control of winter environment—temperature, moisture, odor, drafts, and dust—are insulation and ventilation. In Illinois we have gone rather deeply into these subjects with our farmers. We found that we had to talk about BTU's, U value, R value, cfm, and static pressure. Even a sling psychrometer and a psychrometric chart had been used effectively in some farmer meetings. We used to try to avoid these terms as being too technical, but we found that we had to define insulation specifically because many misconceptions have arisen from misuse of such terms as "insulating" glass, aluminum "insulation," and "insulation" board. We have actually run across some farmers who thought they had insulated their buildings when they applied aluminum roofing.

Overselling of good (but no miracle) insulation materials has also hurt our educational program. I refer specifically to expanded polystyrene. Zealous salesmen have done such a good job of selling this material that farmers practically call us liars when we say that one inch of expanded polystyrene is no better than one inch of mineral wool in insulation value.

But with a persistent and consistent program of county meetings and schools, many of these misunderstandings are being eliminated. Results of a 5-minute quiz given at 47 swine schools in 1963-64 showed that farmers know more about insulating now than they knew a few years ago. Most of them also understand the function of a vapor barrier and know where it should be installed. And ventilation questions have changed from "Do I really need a fan?" to "How big a fan do I need?"

Insulated duct delivers cool air from window air conditioner to snout of sow. Respiration was noticeably lower for this sow than for sows without snout cooling.

Where do we go from here

Now that farmers understand that insulation and fan ventilation are necessary for successfully controlling environment, we can spend more time on the actual mechanics of getting the job done successfully. This is still a big challenge because we are dealing with two things we can't see—air and water vapor. Have you ever stood before an audience and tried to describe a cubic foot of air.

We tell our farmers that the easiest moisture to take out of a building is the part you can't see. But the moisture expelled in respiration doesn't seem to be a problem to them until they see it condense as water or frost. By that time it has not only made everything wet, but must be reevaporated before it can be removed from the building. Teaching farmers about these unseen quantities is difficult.

We have not yet finished the job. So far most of our effort has been concentrated on satisfactory control in winter. Improving control in hot weather will be more difficult, but it may prove even more profitable than wintertime control. We still know little about the effects of spray-cooling hogs. Some air conditioners are being used for snout-cooling in farrowing houses, but profitably cooling the starting building and finishing buildings is still an open field for research and development.

The classroom approach to Extension teaching will be more effective than the general meeting for teaching environment control. One reason is that we will have more time to cover the subject. But I think the greatest benefit is the limited enrollment and nominal registration fee that assures us an interested audience. ■

Engineering the Total Farm Plan

by ROBERT L. MADDEX, *Extension Agricultural Engineer*
and R. G. WHITE, *Extension Agricultural Engineer, Michigan*

HOW DO YOU get the job done well and still make a profit? This is one of the big questions faced by all farm operators. The avalanche of technical information and new mechanization has created many pressures for a change. The price squeeze is forcing higher outputs per man, if a farmer is going to stay alive as a farmer. Strong guidelines are needed by many farm operators and by others servicing agriculture, to help identify the information most valuable to their operation.

Engineering the "Total Farm Plan" is an excellent approach to this problem. This approach will let both the farm operator and the educator come to grips with the problem of getting the total job done. It is a method of sorting, selecting, and putting together the technology and mechanization needed for a business operation. It will also help establish a planning base from which management will become easier.

The approach

When industry builds a new plant, it is designed to process raw materials into a finished product at a pre-established rate. The processes and manpower are selected to do the job necessary to meet production schedules. Farm systems should be engineered using the same basic approach. Industrial plants make adjustments in methods, machinery, and labor to meet changing demands, but there are limits to how far they can go before the plant becomes outdated. The same is true with farm production units.

Approaching the farm operation as a production plant has several distinguishing features. The most important is the establishment of a definite goal of operation. A second is establishment of standards and volume of production. A third is the opportunity to bring into play research findings as the basis for making decisions. Specific recommendations need to be evaluated in terms of the total operation as well as for their individual merit.

Formulas are the tools of engineers. A formula that can help in engineering a total farm plan follows:

$$R = O + T + M$$

R—Results defined in terms of labor income desired or as a specific size of operation.

O—Organization or planned mechanization based on standards for production and mechanization. Field machinery, farmstead equipment, structures, labor, and methods are included in mechanization.

T—Technology in the various disciplines such as dairy, swine, and crop production including the latest in research.

M—Management that includes records, credit use, and evaluation of enterprises and also the skills needed in technology and organization to maximize income.

The difference for the farm operator between this formula and others that have been used is primarily one of scope and focus.

The scope must be broad enough to provide a planning base for the total farm operation.

The focus must be on organization geared for profit by integrating mechanization, technology, and management.

The difference from the Extension worker's standpoint is the approach. It means (1) a broader knowledge and appreciation of the many facets of information that are needed in a farming operation, (2) the development of techniques that foster the cooperation of commodity specialists, economists, and county workers in establishing recommendations, and (3) required standards based on scientific information.

Programming techniques

The most effective technique in developing the engineered farm plan, and the systems to carry out the plan, result from the use of a "planning guide" which is illustrated. Similar guides can be used for other livestock or cropping programs. This simplified planning guide, backstopped by good reference and research information and plenty of scratch paper, provides the wide scope of information that has to be considered, yet focuses on organization to get the job done.

As each section is filled in, questions can be raised to emphasize the standards and practices decided upon. For example, as the feed requirements are decided upon, some of the points that need to be recognized and discussed are listed.

1. What are the feed requirements per animal?
2. When should hay be cut to give maximum milk production?
3. How much silage can be used in a ration?
4. What type of storages are required to maintain feed quality?
5. What are the advantages of high moisture corn?
6. Are crop production levels where they should be?
7. Where are the labor peaks?
8. Will the land permit corn, after corn, after corn?
9. Do you need a nurse crop for seeding forage?
10. Can a crop or set of machinery be eliminated?

Research and field trials will provide the answers to most questions. Specialists from the proper disciplines can evaluate field experiences and cite the research.

Deciding upon a ration and determining the quantities of feed required can provide the basis for other decisions such as: Size and types of storages, kind of mechanization to be used for handling the feed, and type of housing for most effiicient mechanization.

The decisions on feed requirements also point to

machinery needs. Research indicates when hay should be harvested to get the best milk production. With this information, and knowing the tonnage, we can select equipment that will enable the farmer to get the job done on time. The same approach can be used for determining the machinery required for harvesting silage. When tonnages are large, planting dates and variety selection become more important. Maturity can be spread over more days thereby lengthening the harvest period. Again, research can provide good answers to questions raised in this regard.

There will usually be alternate solutions to a particular problem. These alternate solutions can be spelled out, and the best selected for the farm involved. The important thing is to put together a complete system which includes the field machinery, farmstead equipment, structures, and methods required for the job.

As the farm plan develops, dollar signs can be attached. As the dollar signs add up, they can be charged against the income from the milk. The decision about where to spend the dollars becomes easier, and usually more sound.

Working through a planning guide will often bring out much information that the farm operator may not value or be aware of. This experience may also change the biases of both the farmer and the Extension worker.

Considerable time is required to completely work through a guide for a total plan. It can be best done individually or in small groups. It may require two or three planning sessions to actually complete the guide. Once planning is underway, the county agent may be in the best position to follow through with assistance to the farmer.

The planning guide can also be used effectively with large groups. The objectives are somewhat different. With a large group you can:

1. Introduce this technique of planning and get some enthusiasm worked up,
2. Develop some good group discussions that will let research be introduced as a basis for a decision,
3. Suggest that additional information is available and worth investigating, and
4. Set the stage for some productive work with individuals or small groups at a later time.

The planning guides for Total Farm Engineering have been used successfully in Michigan with individuals, small groups, vocational adult classes, groups at general extension meetings, training programs with Extension agents, and commercial representatives.

Information from the planning guides is beginning to appear in commercial literature almost verbatim. Several sales managers from commercial companies serving Michigan have used the planning guides and reference information in company-conducted sales training meetings. The net result is more people providing the same information to farmers.

The purpose of the planning guide is to focus attention on organization and standards of production. Specific recommendations on feed rations, crop selection, herd selection, and similar technology continue to be the responsibility of the subject-matter specialists and the county workers.

The engineered farm plan brings together the specific subject-matter recommendations to establish a planning base. From this planning base, the farm operator can make intelligent decisions as he commits himself and his family to a specialized farming operation. ■

DAIRY PLANNING GUIDE FOR ENGINEERING THE FARM PLAN

1. Herd Numbers
   - Cows in milk .... ________
   - Dry cows (cows in milk x 22%) .... ________
   - Young stock, 10-24 mos. (cows in m. x 53%) ________
   - Young stock, 6 wks.-10 mos. (cows in m. x 29%) ________
   - Calves up to 6 wks. (cows in m. x 17%) .... ________
2. Pounds of milk per cow ________ Total ________
   - Pounds of milk per man ________

FEED REQUIRED (Tons)

3.	*Hay*	*Haylage*	*Corn silage*	*Grain*	*Water*
Mature cows					
Young stock, 10-24 mos.					
Young stock, 6-10 mos.					
Total					
Daily Requirements					

OTHER MATERIALS

	Manure	*Bedding*	*Grd. Feed*	*Milk*
Mature cows				
Young stock, 10-24 mos.				
Young stock, 6-10 mos.				
Total				
Daily Requirements				

SIZE OF STORAGES AND EQUIPMENT

Materials	*Storage*	*Cap.-Tons*	*Size*	*Handling Equip.*

HARVESTING EQUIPMENT AND CAPACITIES

5. (List crops under Item 3)

PLANTING, TILLAGE, AND FERTILIZER PRACTICES

6. (List crops under Item 3)

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Men Or Machines?

A problem many RAD committees have to wrestle with is this: what can we do with—or for—men whose jobs have been taken away by machines?

Here's how some RAD committees have tackled this problem.

Don't fight it

A number of smaller sawmills in Central West Virginia faced extinction. They were just too small to compete with bigger mills. One county RAD committee and Tectional Action Panel after a study, helped the operators of one outmoded mill to get modern technical information to remodel and expand.

The RAD committee feels they did the right thing by facing up to the situation. They substituted mechanized mill equipment for hand labor, figuring that in the long run, employment in timber-cutting and transportation would more than make up for the lost jobs in the obsolete lumber mill.

Labor-saving equipment was installed to improve the mill's competitive position. The mill now handles more lumber than ever, although with fewer workers. But the market for locally-produced timber is improved, providing both temporary and permanent employment for more people in this area. And, more lumber means more jobs transporting it.

New opportunities

There are times when new opportunities present themselves. Take the case of one Minnesota farmer. Four years ago he started making pallets for fork lift trucks. It was a part-time operation in his granary but it gave seasonal work to the farmer and two other men.

The Extension Agent, the Industrial and Forestry committees of the county RAD group, and local businessmen helped the former expand to a full-time pallet-making industry that employes 20 men and uses 80,000 board feet of lumber per month.

New occasions teach new duties

Frequently, RAD committees have taken the lead in focusing attention on the changes in farming, commerce, and industry that call for new skills. They've helped increase emphasis on training and retraining to provide these skills.

Many areas have stepped up adult education. They've added new courses in local schools, and put on specific job training programs to help meet new needs. Local action has often been bolstered by increased State educational assistance. Several recent Federal programs offer help with vocational training.

Upgrading the methods of small businessmen is often as essential as improving skills of the labor force. The University of Arkansas, for instance, has a business management consultant program that provides training on new business methods for foremen, managers and others. Courses are flexible enough in content and scheduling to meet the needs of local business groups.

It's not all roses

Of course, there are times when innovations and improvements may mean fewer job opportunities. RAD committees need constantly to be on the lookout for this possibility, and have alternative prospects in mind.

New industries are nice, but they're not easy to come by. Competition for them is fierce.

Merely having people who want work dosen't sway industrial prospects. But a cooperative and active development group that speaks for a progressive community does. Local government services are important. So are good schools, community recreation, housing, and shopping facilities. Intrinsic benefits such as these are weighed by prospective employers—along with favorable plant sites, utilities, transportation, materials and labor supply, and nearness to markets.

Local citizens need to take a realistic look at their prospects for increasing employment opportunities.

They need to recognize which factors they can meaningfully affect, and those that are beyond their control. There are often times when smaller cities or rural areas can benefit from industrial development in a nearby larger city. When this is the case, it's best for the RAD committee to cooperate—rather than compete—with the development group in the larger city.

And once local citizens have agreed on what they want to do, they need a practical plan to focus their efforts on changing employment opportunities.

This is the crux of Rural Areas Development: thorough understanding of the problem situation, and the forces that can be brought to bear on "solving" that problem; imaginative and able local leadership, committed to working for a solution; and a practical plan of action, persistently pursued.—*Don Dickson, Federal Extension Service.*